IT IS CLAIMED:

1. An automated method of assaying or monitoring the extent of joint or bone deformity in a joint-degenerative or joint-damaging disease in a subject, comprising the steps of

(a) determining from a digitized x-ray image of a patient's selected straight bone that terminates at a joint, coordinates of at least one of the right and left bone contours of a selected bone,

(b) determining from bone contour coordinates determined in step (a), the coordinates of one or more apices in a region adjacent at least one side of the joint formed by the selected bone, and, optionally, the coordinates of a minimum width in the middle region of the bone,

(c) using the coordinates determined in step (b) for selecting a reference joint contour corresponding to one of (i) the contours of confronting joint portions of adjacent straight bones in a normal joint formed by the selected bone; (ii) the contour of a normal joint in a joint region formed by the selected bone; and (iii) the contour from previous x-ray of the subject's bone in the region of the joint, and

(d) guided by the reference joint contour selected in step (c), analyzing a region of the selected joint of the patient, to assay or monitor the extent of bone or joint deformity in the subject.

2. The method of claim 1, wherein the selected bone is a finger phalange terminating in a finger joint, or a toe phalange terminating in a toe joint.

3. The method of claim 2, wherein step (c) includes matching contour coordinates for a selected patient phalange determined from step (b) with one or more of a plurality of normal-phalange templates from a library of templates.

4. The method of claim 3, wherein each normal-phalange template in a library has been generated, for given patient characteristic(s) related to one or more of gender, age, ethnic group, hand size and body size, as a statistical

average of a plurality of normal-phalange templates for the given patient characteristic(s).

5.   The method of claim 2, wherein the selected bone is the middle or
5  proximal phalange of a patient's finger.

6.   The method of claim 5, for use in assaying or monitoring joint space width in a patient joint, wherein

step (c) includes (ci) matching the coordinates of a minimum width in the
10  middle region of the phalange and one or more apices on at least one side of the selected phalange adjacent said joint with corresponding coordinates in a normal-finger template, to identify a normal-finger template that matches the subject phalange, (cii) superimposing the normal-finger template phalange on the image of the patient-finger phalange, and (ciii) using the contours of the
15  template finger to identify a scanning box at one of the joints of the selected phalange, and

step (d) includes (di) scanning one of the joints of the selected phalange within said scanning box, in scanning directions substantially parallel to the axis of the finger, to generate contours of the confronting ends of the phalanges in
20  said joint, (dii) generating profiles of the distances between said confronting phalange bone-end contours within said scan box, and (diii) analyzing said profiles from (ii) to determine the extent of bone loss at said joint, as an indicator of extent or progression of joint-damaging disease in said subject.

25        7.   The method of claim 6, wherein the selected phalange is the middle phalange, and the scanning box is placed at the middle phalange/proximal phalange (MP/PP) joint.

8.   The method of claim 7, wherein step (ci) includes using the
30  coordinates of the minimum middle phalange width to determine a scaling factor for superimposing the template finger of the image of the patient finger.

9. The method of claim 7, wherein step (ci) further includes matching the determined coordinates of a patient-finger middle flange with the corresponding coordinates of the middle phalange of each of a set of template fingers, assessing the difference between the two, and based on this difference, either
5    accepting the template or matching another template from the set.

10. The method of claim 7, wherein step (ciii) includes finding a first line extending through the widest portion of the middle phalange in the region of the MP/PP joint, finding a second line parallel to the first which extends through the
10   widest portion of the adjacent phalange in the region of the same joint, and connecting the two lines with parallel connecting lines to form a rectangular scanning box defined by said widest bone portions.

11. The method of claim 5, wherein step (d) includes successively
15   scanning across said joint, in a direction substantially parallel to the finger axis, and the scan line an incremental distance along the width of the scan box, until scans along the entire width of the box have been taken.

12. The method of claim 11 wherein the selected phalange is the middle
20   phalange, and the scanning box is placed at the middle phalange/proximal phalange (MP/PP) joint, and step (dii) includes comparing the distances at each point along the scan box in said profile with those representative of a normal-subject MP/PP joint from the same finger as the patient finger.

25      13. The method of claim 5, for use in assaying or monitoring bone erosion in a patient joint, wherein
         step (c) includes (ci) from the determined coordinates of the contours of the selected phalange, identifying a pair of apices on at least one side of the selected phalange adjacent said joint, and (cii) constructing a straight line
30   between each the apices in each pair, where said straight line represents a reference joint contour adjacent the joint region of the selected phalange, and

step (d) includes comparing the straight line contour between a pair of apices with the actual patient contour between the same two points, to determine the extent of concavity of said region with respect to the straight line extending between the two apices.

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14. The method of claim 13, wherein the selected phalange is the proximal phalange, and the joint is the MP/PP joint.

15. The method of claim 5, for use in assaying or monitoring bone

10    erosion in a patient joint, wherein

step (c) includes (ci) matching the coordinates of a minimum width coordinate in the middle region of the phalange and one or more apices on at least one side of the selected phalange adjacent said joint with corresponding coordinates in a partial or complete normal-finger template, to identify a joint

15    region of a normal-finger phalange template that matches the subject finger joint region, and (cii) superimposing the contour of the template phalange joint region on the image of the patient-finger phalange joint region, where the template contour represents a reference joint contour adjacent the joint region of the selected phalange, and

20    step (d) includes comparing the template line contour in the joint region with the actual patient contour in the same region, to determine the extent to which the actual patient contour deviates from the normal-phalange contour.

16. The method of claim 15, wherein the selected phalange is the

25    proximal phalange, and the joint is the MP/PP joint.

17. The method of claim 5, for use in assaying or monitoring bone erosion in a patient joint, wherein

step (c) include (ci) matching the coordinates of a minimum width

30    coordinate in the middle region of the phalange and one or more apices on at least one side of the selected phalange adjacent said joint with corresponding coordinates in a previous patient x-ray image of the finger phalange, and (cii)

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superimposing the contour of the previous x-ray image phalange joint region on the image of the patient-finger phalange joint region, where the previous-patient contour represents a reference joint contour adjacent the joint region of the selected phalange, and

5          step (d) includes comparing the previous-image contour in the joint region with the actual patient contour in the same region, to determine the extent to which the actual patient contour deviates from the previous-image contour.

18.  The method of claim 17, wherein the selected phalange is the
10. proximal phalange, and the joint is the MP/PP joint.

19.  A machine readable code which controls the operation of an electronic computer to carry out a method for assaying or monitoring the extent of joint or bone deformity in a joint-degenerative or joint-damaging disease in a
15  subject, comprising the steps of

(a) determining from a digitized x-ray image of a patient's selected straight bone that terminates at a joint, coordinates of at least one of the right and left bone contours of a selected bone,

(b) determining from bone contour coordinates determined in step (a); the
20  coordinates of one or more apices in a region adjacent at least one side of the joint formed by the selected bone, and, optionally, the coordinates of a minimum width in the middle region of the bone,

(c) using the coordinates determined in step (b) for selecting a reference joint contour corresponding to one of (i) the contours of confronting joint portions
25  of adjacent straight bones in a normal joint formed by the selected bone; (ii) the contour of a normal joint in a region adjacent at least one side of the joint formed by the selected bone. and (iii) the contour of the subject's joint in a region adjacent at least one side of the joint formed by the selected bone, and

(d) guided by the reference joint contour selected in step (c), analyzing a
30  region of the selected joint of the patient, to assay or monitor the extent of joint or bone deformity in the subject.

20.  The code of claim 19, wherein the selected bone is a finger phalange defining a finger joint, or a toe phalange defining a toe joint.

21.  The code of claim 20, wherein the selected bone is a middle or
5   proximal phalange of a patient's finger. .

22.  The code of claim 21, for use in assaying or monitoring joint space width in a patient joint, wherein
     step (c) includes (ci) matching the coordinates of a minimum width in the
10  middle region of the phalange and one or more apices on at least one side of the selected phalange adjacent said joint with corresponding coordinates in a normal-finger template, to identify a normal-finger template that matches the subject phalange, (cii) superimposing the normal-finger template phalange on the image of the patient-finger phalange, and (ciii) using the contours of the
15  template finger to identify a scanning box at one of the joints of the selected phalange, and
     step (d) includes (di) scanning one of the joints of the selected phalange within said scanning box, in scanning directions substantially parallel to the axis of the finger, to generate contours of the confronting ends of the phalanges in
20  said joint, (dii) generating profiles of the distances between said confronting phalange bone-end contours within said scan box, and (diii) analyzing said profiles (ii) to determine the extent of bone loss at said joint, as an indicator of extent or progression of joint-damaging disease in said subject.

25       23. The code of claim 21, for use in assaying or monitoring bone erosion in a patient joint, wherein
     step (c) includes (ci) from the determined coordinates of the contours of the selected phalange, identifying a pair of apices on at least one side of the selected phalange adjacent said joint, and (cii) constructing a straight line
30  between each the apices in each pair, where said straight line represents a reference joint contour adjacent the joint region of the selected phalange, and

step (d) includes comparing the straight line contour between a pair of apices with the actual patient contour between the same two points, to determine the extent of concavity of said region with respect to the straight line extending between the two apices.

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24.  The code of claim 21, for use in assaying or monitoring bone erosion in a patient joint, wherein

step (c) includes (ci) matching the coordinates of a minimum width coordinate in the middle region of the phalange and one or more apices on at

10  least one side of the selected phalange adjacent said joint with corresponding coordinates in a partial or complete normal-finger template, to identify a joint region of a normal-finger phalange template that matches the subject finger joint region, and (cii) superimposing the contour of the template phalange joint region on the image of the patient-finger phalange joint region, where the template

15  contour represents a reference joint contour adjacent the joint region of the selected phalange, and

step (d) includes comparing the template line contour in the joint region with the actual patient contour in the same region, to determine the extent to which the actual patient contour deviates from the normal-phalange contour.

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25.  The code of claim 21, for use in assaying or monitoring bone erosion in a patient joint, wherein

step (c) include (ci) matching the coordinates of a minimum width coordinate in the middle region of the phalange and one or more apices on at

25  least one side of the selected phalange adjacent said joint with corresponding coordinates in a previous patient x-ray image of the finger phalange, and (cii) superimposing the contour of the previous x-ray image phalange joint region on the image of the patient-finger phalange joint region, where the previous-patient contour represents a reference joint contour adjacent the joint region of the

30  selected phalange, and

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step (d) includes comparing the previous-image contour in the joint region with the actual patient contour in the same region, to determine the extent to which the actual patient contour deviates from the previous-image contour.

5       26. An automated system for use in assaying or monitoring the extent of joint or bone deformity in a joint-degenerative or joint-damaging disease in a subject, comprising

      (A) an electronic computer, and

      (B) machine readable code which controls the operation of the computer

10   to carry out the steps in the method of claim 1, where the selecting step in the claimed method includes matching contour coordinates for a selected patient phalange determined from step (b) with each of a plurality of normal-phalange templates from a library of templates, and

      (C) .a library of normal-phalange templates which is accessible by said

15   code for use in carrying out step (c) in the method.

      27. The system of claim 25, wherein each normal-phalange template in a library has been generated, for given patient characteristic(s) related to one or more of gender, age, ethnic group, hand size and body size, as a statistical

20   average of a plurality of normal-phalange templates for the given patient characteristic(s).